UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/732,927	12/10/2003	Jorge L. Gardea-Torresdey	UTSE:103US	7368

7590 01/13/2005

FULBRIGHT & JAWORSKI L. L. P.
SUITE 2400
600 CONGRESS AVENUE
AUSTIN, TX 78701-3271

EXAMINER	
FORD, ALLISON M	
ART UNIT	**PAPER NUMBER**
1651	

DATE MAILED: 01/13/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Applicati n N .	Applicant(s)
	10/732,927	GARDEA-TORRESDEY ET AL.
	Examiner	**Art Unit**
	Allison M Ford	1651

-- Th MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-23 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-23 is/are rejected.

7)☒ Claim(s) 6 and 21-23 is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 17 September 2004 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Priority

Acknowledgement is made of applicant's claim for priority to provisional application 60/432,160, filed 12/10/2002.

Information Disclosure Statement

The listing of references in the specification is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609 A(1) states, "the list may not be incorporated into the specification but must be submitted in a separate paper." Therefore, unless the references have otherwise been cited by the examiner on form PTO-892, only the references actually cited on the IDS, filed 3/22/04 have been considered.

Claim Objections

Claim 21 is objected to because of the following minor grammatical error: step (i) should read, "selecting a desired particle size;" and step (ii) should read, "...concentration to produce said desired particle size."

Claim 6 is objected to be cause of the following informality: Magnoliophyta is a phylum; it should not be referred to as a phylum and not a division.

Claims 22 and 23 are objected to because of the following minor informalities: the characteristic "crystalline" would more appropriately be stated as "crystalline structure," as it is in reference to the structural characteristic of the nanoparticles. Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1, 5 and 6 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for alfalfa, does not reasonably provide enablement for any plant, any dicot or even any dicot of the phylum Magnoliophyta. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

While applicant does provide a representative number of species of plants and a representative number of dicots, their examples of successfully producing the precious metal nanoparticles, as well as the examples provided in the references, are limited to use of alfalfa. Alfalfa has demonstrated an inherent ability to tolerate growth in environments with high concentrations of heavy metals, a unique property, as high heavy metal concentrations are lethal to many plants (See Gardea-Torresdey et al, *J of Hazardous Materials*, 1999, pg 42 & Gardea-Torresdey et al, *Nano Letters*, 2002, pg 397, col. 2); however there is no disclosure or explanation of this inherent ability to thrive in the high metal concentration environments, or any disclosure or explanation of the alfalfa's ability to produce metal nanoparticles. Therefore, while applicant has enabled for success with the use of alfalfa, they have not provided evidence of similar success with a sufficient number of representative species which is required to claim all Magnoliophytas, all dicots, or all plants.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-23 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Applicant's claim 1 is directed to a method of producing a precious metal nanoparticle in a plant, comprising (a) selecting a plant growth environment comprising a precious metal source; (b) growing a plant in said plant environment; and (c) isolating said precious metal nanoparticle. It is not clear if the method is intended to produce the precious metal nanoparticle inside the plant, as suggested by the preamble, or if the method is intended to isolate the precious metal nanoparticle from the plant, as suggested in step (c). Claims 2-23 have the limitation of claim 1 and thus are rejected on the same basis.

Applicant's claim 8 is directed to the method of claim 1, wherein isolating comprises isolating a part of said plant. Claim 9 requires the plant part to be a leaf, a stem, or a root. As is, applicant's claim is so broad as to read on simply picking a leaf or stem from a plant grown in the appropriate environment; it is not clear if this is applicant's intent or if further isolation steps are required. Claims 9-14 have the limitation of claim 8, and thus are rejected on the same basis.

Applicant's claim 12 requires the plant part to be disrupted by chemical means including digestion or extraction. It is not clear how a plant part is "extracted." It appears, rather, that the metal particles are meant to be extracted in subsequent steps not described in the claim.

Applicant's claim 14 is directed to the method of claim 8, wherein isolating comprises one or more of chromatography, centrifugation, or electrophoresis. However, claim 8 is directed to a method of producing a precious metal nanoparticle in a plant comprising (a) selecting a plant growth environment comprising a precious metal source; (b) growing a plant in said plant environment; and (c) isolating said precious metal nanoparticle, wherein isolating comprises isolating a part of said plant. It is not clear if the part of the plant isolated in claim 8 is to be further subjected to the chromatography, centrifugation or electrophoresis of claim 14; if so, it appears as if there is an omission of an essential step of breaking down the plant part. For example, if a leaf is isolated from the plant, it must first be physically broken

down into a slurry-like composition before it can be further subjected to chromatography, centrifugation, or electrophoresis.

Applicant's claim 16 is directed to the method of claim 1, further comprising creating said plant growth environment comprising a precious metal source. It is not clear if this step is performed in addition to the steps of (a) selecting a plant growth environment comprising a precious metal source; (b) growing a plant in said plant environment; and (c) isolating said precious metal nanoparticle, or if it is in alternative to step (a) selecting a plant growth environment comprising a precious metal source. Furthermore, it is not clear how the plant growth environment comprising a precious metal source is created. While claims 18 and 21 describe more clearly how the environment is created, claim 16 must be able to stand on its own. Still further, it is not clear why one would create a plant environment comprising a precious metal source, only to isolate the precious metal source; it is not clear if something happens to the metal source while in the plant that cannot happen by other means. Claims 17-21 have the limitation of claim 16, and thus are rejected on the same basis.

Applicant's claim 17 requires the plant growth environment to be soil or liquid. Due to the limitation of claim 19, it appears applicant intended for this to require the plant growth environment to be solid or liquid, examination was conducted as such. However, as is, claim 19 recites the limitation "said *solid* growth medium." As written, there is insufficient antecedent basis for this limitation in the claim.

Applicant's claim 21 is directed to the method of claim 16, and requires creating said plant growth environment comprises: (i) selecting a desired particle size; and (ii) adjusting the precious metal concentration to produce said desired particle size. It is not clear if "particle size" is referring to the nanoparticles of precious metal referenced in claim 1, or other components of soil. If the precious metal nanoparticles are being referenced, the term "precious metal nanoparticles" should be used consistently throughout the application. Additionally, it is not clear how the precious metal concentration produces particles of a desired size, whatever the particles may be. Applicant has provided no information or

description on how the concentration of metal correlates to the size of the nanoparticles. Gardea-Torresdey et al (*J. of Nanoparticle Research*, 1999) teaches that the shape of the nanoparticles cause variations in size, but they do not provide any teachings, that could be incorporated by reference, on the concentration having any correlation to the size.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 2, 5-9, 15-20 & 22 are rejected under 35 U.S.C. 102(a) as being anticipated by Gardea-Torresdey et al (*Nano Letters*, Jan. 30, 2002).

Gardea-Torresdey et al teach a method of producing a precious metal nanoparticle from plants, comprising creating a plant growth environment comprising gold(III) in agar; planting alfalfa seeds in the agar; allowing the plants to grow; harvesting the alfalfa roots and shoots part of the plant (which applicant calls isolating the precious metal nanoparticles); and identifying gold in the sample (See pg. 398) (Claims 1, 2, 5-9 & 15-20). Gardea-Torresdey et al teach the some gold nanoparticles produced in the plants have an icosahedron (crystalline) structure with an approximate size of 4 nm, other nanoparticles were identified with a fcc twinned structure and an approximate size of 6-10 nm (See Pg 401) (Claim 22). Therefore the reference anticipates the claimed subject matter.

Claims 1, 5, 8-10, 12 & 15 are rejected under 35 U.S.C. 102(b) as being anticipated by Gardea-Torresdey et al (US Patent 5,927,005), in light of USDA "Plants Profile."

Gardea-Torresdey et al teach a method of recovering heavy metals from contaminated soils comprising selecting a plant growth environment comprising a heavy metal source, growing a plant in the plant growth environment, and isolating heavy metal nanoparticles (Claim 1). Gardea-Torresdey et al define "heavy metals" as any metal having a molecular weight greater than sodium (MW= 22.99g/mol) (See col. 1, ln 22-24), therefore including precious metals such as gold (MW=197.0 g/mol), silver (MW=107.9 g/mol), and platinum (MW=195.1). Gardea-Torresdey et al use creosote bushes (*Larrea tridentata),* a dicot, to absorb the heavy metals from contaminated ground (See col. 1, ln 10-15 & USDA "Plants Profile"). The plants can grow naturally in the contaminated environment, or they can be grown by planting a seed, a sprout, or a grown plant (See col. 3, ln 33-46) (Claim 15). The heavy metals are isolated by removing a leaf, stem, or root of the plant (Claims 8-9). The metals are then extracted from the leaves by chemically disrupting the plant by treating the plant with acid or other metal chelators (See col. 3, ln 5-33) (Claims 10 & 12). The slurry is then subjected to isolation procedures (See col. 6, ln 5-58). Therefore the reference anticipates the claimed subject matter.

Claims 1-3, 5, 8, 9 & 15-19 are rejected under 35 U.S.C. 102(b) as being anticipated by Raskin et al (US Patent 5,785,735).

Raskin et al teach a method of removing metal ions from soil, comprising selecting a plant growth environment comprising a metal source or creating a plant growth environment by adding metal ions to a soil pot; growing plant in said plant growth environment by transplanting sprouts; and isolating the metal particles by harvesting the roots and shoots (leaves and stem) of the plants and measuring the metal content (See col. 9, ln 55- col. 10, ln 45 & Table 1) (Claims 1, 8-9 & 15-19). Raskin et al used plants from the family *Brassicaceae*, for example, *Brassica juncea*, a dicot (See col. 10, ln 48-60) (Claim 5). Raskin et al teach this method can be used to remove a variety of metals, including gold and silver (See col. 5, ln 12-20) (Claims 2 and 3). Therefore the reference anticipates the claimed subject matter.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 10-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gardea-Torresdey et al (*Nano Letters*, Jan. 30, 2002).

Gardea-Torresdey et al teach a method of producing a precious metal nanoparticle from plants, comprising creating a plant growth environment comprising gold(III) in agar; planting alfalfa seeds in the agar; allowing the plants to grow; harvesting the alfalfa roots and shoots part of the plant (which applicant calls isolating the precious metal nanoparticles); and identifying gold in the sample (See pg. 398). Gardea-Torresdey et al teach the some gold nanoparticles produced in the plants have an icosahedron (crystalline) structure with an approximate size of 4 nm, other nanoparticles were identified with a fcc twinned structure and an approximate size of 6-10 nm (See Pg 401).

Though Gardea-Torresdey et al do not teach disrupting the plant part before analysis of the gold contents, it would have been obvious to one of ordinary skill in the art at the time the invention was made to first disrupt the harvested plant part by physical, chemical, or biological methods (Claim 10). One of ordinary skill in the art would have been motivated to first disrupt the harvested plant parts to liberate the contents of the plant for purposes of analysis. Such physical means of disruption could include pressing, grinding, sonicating or burning (Claim 11). Such chemical means include digestion or extraction (Claim 12). Such biological means could include enzymatic degradation or microbial degradation (Claim 13). One would have expected success with any of these means of disruption because they are all commonly known in the art as successful methods of breaking down biological material into a slurry for the purposes

of analysis. Additionally, once the plant part is disrupted, it would have been obvious to one of ordinary skill in the art to remove excess cellular debris by means of chromatography, centrifugation or electrophoresis (Claim 14). The skilled artisan would have been motivated to perform chromatography, centrifugation or electrophoresis in order to separate large, undigested or non-disrupted pieces of plant material, that were not broken down during disruption to allow for easier analysis of the metal nanoparticles present in the remaining supernatant. One would have expected success because centrifugation, chromatography and electrophoresis are well known methods in the art for separation and purification of heterogeneous mixtures. Therefore the invention as a whole would have been *prima facie* obvious to one of ordinary skill in the art at the time the invention was made.

Claims 2-4 & 10-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gardea-Torresdey et al (US Patent 5,927,005).

Gardea-Torresdey et al teach a method of recovering metals from contaminated soils comprising selecting a plant growth environment comprising a heavy metal source, growing a plant in the plant growth environment, and isolating heavy metal nanoparticles. Gardea-Torresdey et al use creosote bushes (*Larrea tridentata)* to absorb the heavy metals from contaminated ground (See col. 1, ln 10-15). The heavy metals are drawn into the plant and isolated by removing a leaf, stem, or root of the plant; the metals are then extracted from the leaves by chemically disrupting the plant by treating the plant with acid or other metal chelators (See col. 3, ln 5-33). The slurry is then subjected to isolation procedures (See col. 6, ln 5-58). Though Gardea-Torresdey et al teach a variety of chemical reactions that can be used to disrupt the plant parts through digestion by metal chelating agents, it would have also been obvious to one of ordinary skill in the art at the time the invention was made to use any well known method to disrupt the plant material, such as physically grinding, e.g. in a blender, sonicating, or burning the plant parts, or biologically disrupting the plant material with enzymatic or microbial degradation, such as with cellulase

(Claims 10-13 One would have expected success with any of these means of disruption because they are all commonly known in the art as successful methods of breaking down biological material into a slurry for the purposes of analysis. Additionally, once the plant part is disrupted, it would have been obvious to one of ordinary skill in the art to remove excess cellular debris by means of chromatography, centrifugation or electrophoresis (Claim 14). The skilled artisan would have been motivated to perform chromatography, centrifugation or electrophoresis in order to separate large, undigested or non-disrupted pieces of plant material, that were not broken down during disruption to allow for easier analysis of the metal nanoparticles present in the remaining supernatant. One would have expected success because centrifugation, chromatography and electrophoresis are well known methods in the art for separation and purification of heterogeneous mixtures.

Additionally, though Gardea-Torresdey et al do not specifically teach isolating gold, silver, or platinum, it would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize this method to isolate any heavy metal from contaminated soil. One of ordinary skill in the art would have been motivated to remove gold, silver or platinum from contaminated soil in order to isolate these precious metals for their monetary worth as well as their usefulness in the nanotechnology field. One would have expected success because Gardea-Torresdey et al define "heavy metals" as any metal having a molecular weight greater than sodium (MW= 22.99g/mol) (See col. 1, ln 22-24), therefore precious metals such as gold (MW=197.0 g/mol), silver (MW=107.9 g/mol), and platinum (MW=195.1) would also be expected to be isolated by this method. Therefore the invention as a whole would have been *prima facie* obvious to one of ordinary skill in the art at the time the invention was made.

Claims 10-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raskin et al (US Patent 5,785,735).

Raskin et al teach a method of removing metal ions from soil, comprising selecting a plant growth environment comprising a metal source or creating a plant growth environment by adding metal ions to a soil pot; growing plant in said plant growth environment by transplanting sprouts; and isolating the metal particles by harvesting the roots and shoots (leaves and stem) of the plants and measuring the metal content (See col. 9, ln 55- col. 10, ln 45 & Table 1). Raskin et al used plants from the family *Brassicaceae*, for example, *Brassica juncea*, a dicot (See col. 10, ln 48-60) (Claim 5). Raskin et al teach this method can be used to remove a variety of metals, including gold and silver (See col. 5, ln 12-20).

Though Raskin et al teach measuring the metal content of the plants, they do not teach a method of disrupting the plants by physical, chemical or biological methods. However, it would have been obvious to one of ordinary skill in the art at the time the invention was made first disrupt the harvested plant parts by physical, chemical, or biological means to create a slurry, and then to isolate the metal particles by an appropriate method such as centrifugation, chromatography, or electrophoresis (Claims 10-14). One of ordinary skill in the art would have been motivated to isolate the particles by first disrupting the plant parts to liberate the contents of the plant for purposes of analysis. Such physical means of disruption could include pressing, grinding, sonicating or burning (Claim 11). Such chemical means include digestion or extraction (Claim 12). Such biological means could include enzymatic degradation or microbial degradation (Claim 13). One would have expected success with any of these means of disruption because they are all commonly known in the art as successful methods of breaking down biological material into a slurry for the purposes of analysis. Additionally, once the plant part is disrupted, it would have been obvious to one of ordinary skill in the art to remove excess cellular debris by means of chromatography, centrifugation or electrophoresis (Claim 14). The skilled artisan would have been motivated to perform chromatography, centrifugation or electrophoresis in order to separate large, undigested or non-disrupted pieces of plant material, that were not broken down during disruption to allow for easier analysis of the metal nanoparticles present in the plant slurry. One would have

expected success because centrifugation, chromatography and electrophoresis are well known methods in the art for separation and purification of heterogeneous mixtures.

Claims 1-20 & 22-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gardea-Torresdey et al (*J of Nanoparticle Research*, 1999), in view of Gardea-Torresdey et al (*J of Hazardous Materials*, 1999).

Gardea-Torresdey et al teach a method of producing gold nanoparticles using alfalfa biomass, comprising combining alfalfa biomass with a 0.1 mM gold(III) solution, and then removing the bound gold nanoparticles from the alfalfa biomass by centrifuging the samples, the supernatant solution was then analyzed (See *J of Nanoparticle Research*, pg 399). The gold nanoparticles Gardea-Torresdey et al observed had a variety of crystalline structures including tetrahedral, icosahedral and other irregular shapes. The decahedral and icosahedral particles showed a twinned structure (See *J of Nanoparticle Research*, Pg 39-400). The icosahedral and irregular shaped particles were the smallest, with diameters of about 15 nm (See *J of Nanoparticle Research*, Fig. 2 & 7 and Pg 400-401). The nanoparticles were zero valence, they were gold(0) (See *J of Nanoparticle Research*, pg 397 & 402) (Claim 22).

Though Gardea-Torresdey et al do not teach growing the alfalfa plants in an environment that comprises a metal source, they do demonstrate the inherent ability of the alfalfa plant to remove and recover precious metal nanoparticles from a gold-containing solution; contact with the alfalfa is all that appears to be necessary for the isolation and extraction of the metal ions from a metal ion-containing solution. Therefore it would have been obvious to one of ordinary skill in the art to isolate precious metal nanoparticles by growing an alfalfa plant in an environment that contains metal ions and then isolating the precious metal nanoparticles from the plant (Claims 1, 2 & 5-7). The environment could be selected due to a naturally high occurrence of metal ions, or the metal ions could be artificially added to the environment; the growth environment can consist of any suitable substrate, including soil, agar, or liquid

(Claims 16-20). The alfalfa plants could be grown in any appropriate manner, including planting seeds, planting a sprout, or transplanting an entire plant (Claim 15). One of ordinary skill in the art would have been motivated to select or create a growth environment of soil, agar or liquid in order to isolate the precious metals from other sources for use in nanotechnology applications, as described by Gardea-Torresdey et al. One would expect success growing the alfalfa plants in soil, agar or liquid because these are all suitable growth environments for the plant, and one would have expected success growing the alfalfa plants in the presence of heavy metals because Gardea-Torresdey et al teach that the alfalfa plant is especially tolerant to growing in soil environments contaminated with heavy metals (See *J of Hazardous Materials,* pg 42).

Once the plant had grown in the presence of the metal, due to its inherent ability to remove and recover the metal from its surroundings and produce nanoparticles of the metal, as taught by Gardea-Torresdey et al, it would be obvious to one of ordinary skill in the art to isolate the nanoparticles by appropriate methods, including isolating part of the plant. Gardea-Torresdey et al teach both the roots and shoots are capable of producing the nanoparticles (See pg. 397), disrupting the plant part by physical, chemical, or biological means to create a slurry, and isolating the metal nanoparticles by an appropriate method such as centrifugation, chromatography, or electrophoresis (Claims 8-14). One of ordinary skill in the art would have been motivated to isolate the nanoparticles by first disrupting the plant parts to liberate the contents of the plant for purposes of analysis. Such physical means of disruption could include pressing, grinding, sonicating or burning (Claim 11). Such chemical means include digestion or extraction (Claim 12). Such biological means could include enzymatic degradation or microbial degradation (Claim 13). One would have expected success with any of these means of disruption because they are all commonly known in the art as successful methods of breaking down biological material into a slurry for the purposes of analysis. Additionally, once the plant part is disrupted, it would have been obvious to one of ordinary skill in the art to remove excess cellular debris by means of chromatography,

centrifugation or electrophoresis (Claim 14). The skilled artisan would have been motivated to perform chromatography, centrifugation or electrophoresis in order to separate large, undigested or non-disrupted pieces of plant material, that were not broken down during disruption to allow for easier analysis of the metal nanoparticles present in the plant slurry. One would have expected success because centrifugation, chromatography and electrophoresis are well known methods in the art for separation and purification of heterogeneous mixtures.

Finally, though Gardea-Torresdey et al (*J of Nanoparticle Research*) use gold as the only metal in the metal-containing solution, it would have been obvious to one of ordinary skill in the art to extract other metals from an environment that contains other metals, such as silver and platinum. One of ordinary skill in the art would have been motivated to extract other metals such as silver and platinum for use in nanotechnology. Gardea-Torresdey et al (*J of Nanoparticle Research*) teach that the use of metal nanoparticles for nanoelectronic devices is a developing field (See pg 397); therefore one would be motivated to use nanoparticles that can easily be produced and extracted from the common alfalfa plant. One would expect success producing silver and platinum nanoparticles because Gardea-Torresdey et al (*J of Nanoparticle Research*) teach success with gold, and Gardea-Torresdey et al (*J of Hazardous Materials)* teach similar success extracting other various heavy metals, such as cadmium, chromium, copper, lead, nickel, and zinc. Therefore it appears the alfalfa plant is capable of the same extraction and nanoparticle producing action on all heavy metals, and thus would act similarly on silver and platinum (Claims 3, 34 & 23). Therefore the invention as a whole would have been *prima facie* obvious to one of ordinary skill in the art at the time the invention was made.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allison M Ford whose telephone number is 571-272-2936. The examiner can normally be reached on M-F 7:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Wityshyn can be reached on 571-272-0926. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Allison M Ford
Examiner
Art Unit 1651

LEON B. LANKFORD, JR.
PRIMARY EXAMINER